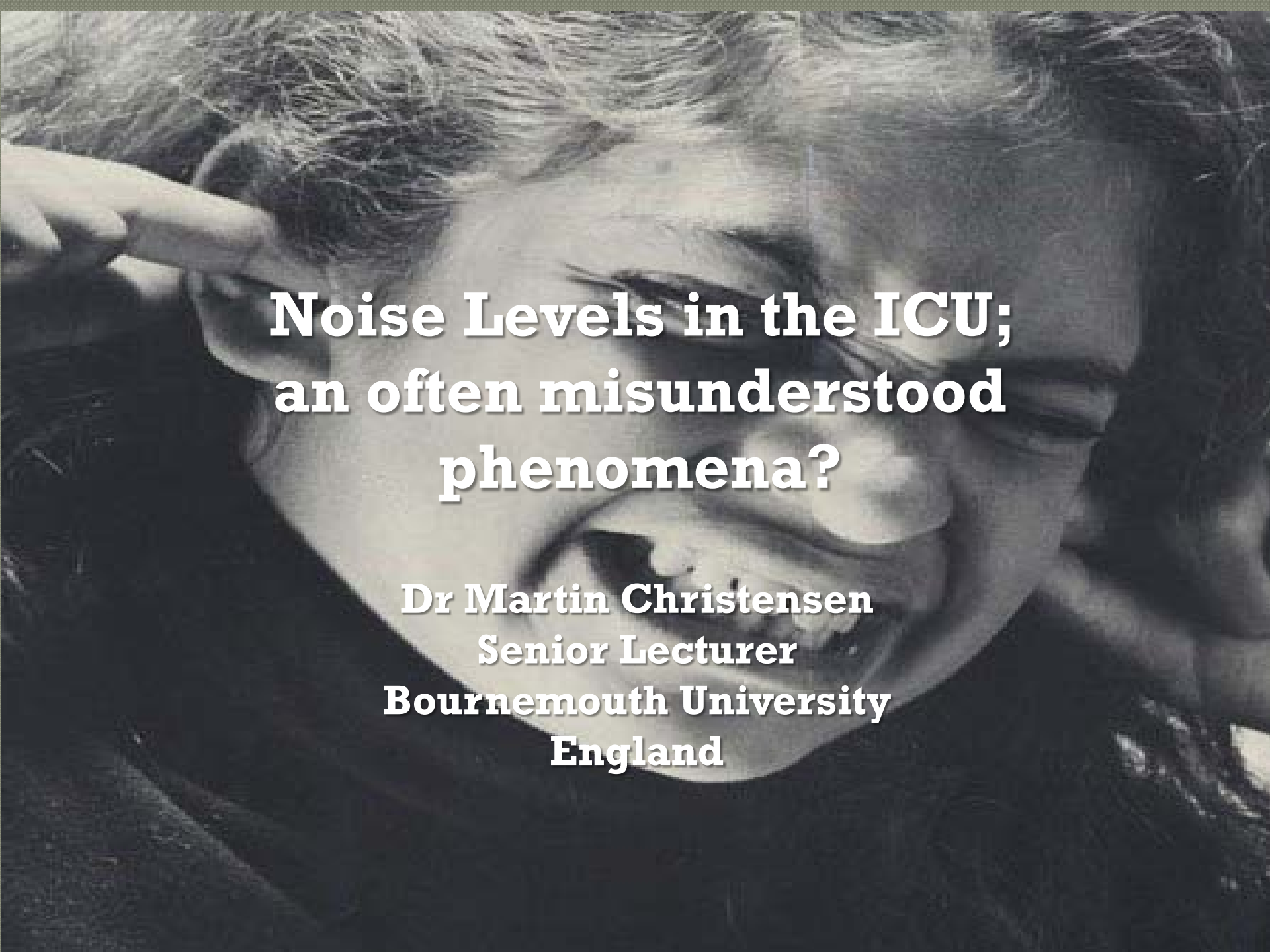


Noise Levels in the ICU; an often misunderstood phenomena?

Dr Martin Christensen
Senior Lecturer
Bournemouth University
England

"Unnecessary noise is the most cruel absence of care which can be inflicted either on the sick or well."

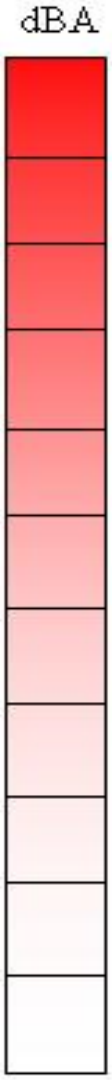
The fidget of silk and of crinoline, the rattling of keys, the creaking of stays and of shoes, will do a patient more harm than all the medicines in the world will do him good.

Florence Nightingale: Notes on Nursing 1863

Defining Noise Exposure

Noise has been defined as being any sound that is unwanted due to either its physical characteristics such as sound pressure level, frequency or duration, or to subjective criteria. For example, a sound may be unwanted because it is annoying, intrusive or as a result of its meaning in a particular context. Noise exposure can differ in its nature either as a pressure wave or as a broad band sound such as seen with tele[illegible]. For example, a siren, impact noise or impulse or as a musical sound with or without unwanted qualities such as pitch or tonality. Noise exposure can also be defined as being either steady state or fluctuating in performance.

Examples of Common Noise Levels



dBA	
130	Threshold of pain
120	Jet aircraft takeoff at 100 feet
110	Riveting machine at operator's position
100	Cutoff saw at operator's position
	Car horn at 10 feet
90	Industrial boiler room
	Bulldozer at 50 feet
80	Sports car interior at 60 mph
	Diesel locomotive at 600 feet
70	Quiet air compressor at 50 feet
60	Normal conversation at 5-10 feet
50	Open office area background level
40	
	Residential background level
30	Soft whisper at 2 feet
	Recording studio
20	

Environment	Critical Health Effect	Sound Level dB(A)*
Bedrooms	Sleep disturbance	30
Indoor dwellings	Speech intelligibility	35
School classrooms	Disturbance of communication	35
Outdoor living areas	Annoyance	50 - 55
Industrial, commercial and traffic areas	Hearing impairment	70
Music through earphones	Hearing impairment	85
Ceremonies and entertainment	Hearing impairment	100

Sound Conduction

Sound Energy

Gather & Amplify Sound

Auricle
External Auditory Canal
Tympanic Membrane

Middle Ear

Transduction of Sound

Malleus, Incus, Stapes
Oval Window
Cochlea
Basilar Membrane Vibration

8th Cranial Nerve
(Vestibulocochlear)

Hypothalmus

Primary Auditory
Pituitary Gland
(B ea)

Sympathetic Nervous System & Adrenal Gland Stimulation

The Effects of Excessive Noise Exposure

Adrenaline & Noradrenaline

- Inhibit Insulin secretion
- Block uptake of glucose by peripheral tissues

- Impair chemostaxis
- Slow Neutrophil migration
- Prolonged cellular mitosis

- Increased peripheral vasoconstriction
- Decreased stroke volume

Hypertension

Tachycardia

Marshall, 1972; Falk and Woods, 1973 ; Monjan and Collector, 1977; Andren, 1980; Snyder-Halpern, 1985; Baker, 1992; McCarthy et al., 1992; Baker et al., 1993; Wysocki, 1996

The Effects of Excessive Noise Exposure

Psychological

Hypoalert-Hypoactive

- Slowed psychomotor function
- Lethargic
- Confused
- Sedated
- Reduced awareness
- Poor attention span
- Drowsy
- Withdrawn
- Apathetic

Hyperalert-Hyperactive

- Restless
- Agitated
- Suffer hallucinations and delusions
- Paranoia
- Disorientation
- Pulling at invasive lines or monitoring equipment
- Aggressive
- Combative

Legislation

Health & Safety Law

The World Health Organization's (WHO 2003) Guidelines for Community Noise.

United Kingdom 85dB(A)

Australia 85dB(A)

New Zealand 85dB(A)

40 dB(A)

30 dB(A)

Reduce Noise Induced Hearing Loss

Noise Levels in the ICU

a Review of the Literature

The Average Noise Level ranged between 59-83dB(A)

Mechanical Noise	Human Noise
48-80dB(A)	58-62dB(A)
20%	80%

Falk and Woods, 1973; Bentley et al., 1977; Hilton, 1985 Balogh et al., 1993; Kam et al., 1994; Meyer-Falcke et al., 1994; Christensen, 1997; Kahn et al., 1998; Chmiel et al., 2004

How does this compare with other Hospital Environments

Journal of Advanced Perioperative Care, 2004, 2(1), 19-26. Journal of Clinical Nursing, 2004, 14, 156–164

General Surgical Ward - Mean 42.28dB(A) [L36, H70]

Operating Theatre – Mean 50.93dB(A) [L45, H80]

Recovery Room – Mean 47.57dB(A) [L43, H70]

80-95% of all noise generated in these areas was due to the presence of staff ($r = 0.881; 0.897 \& 0.950; P \leq 0.001$)

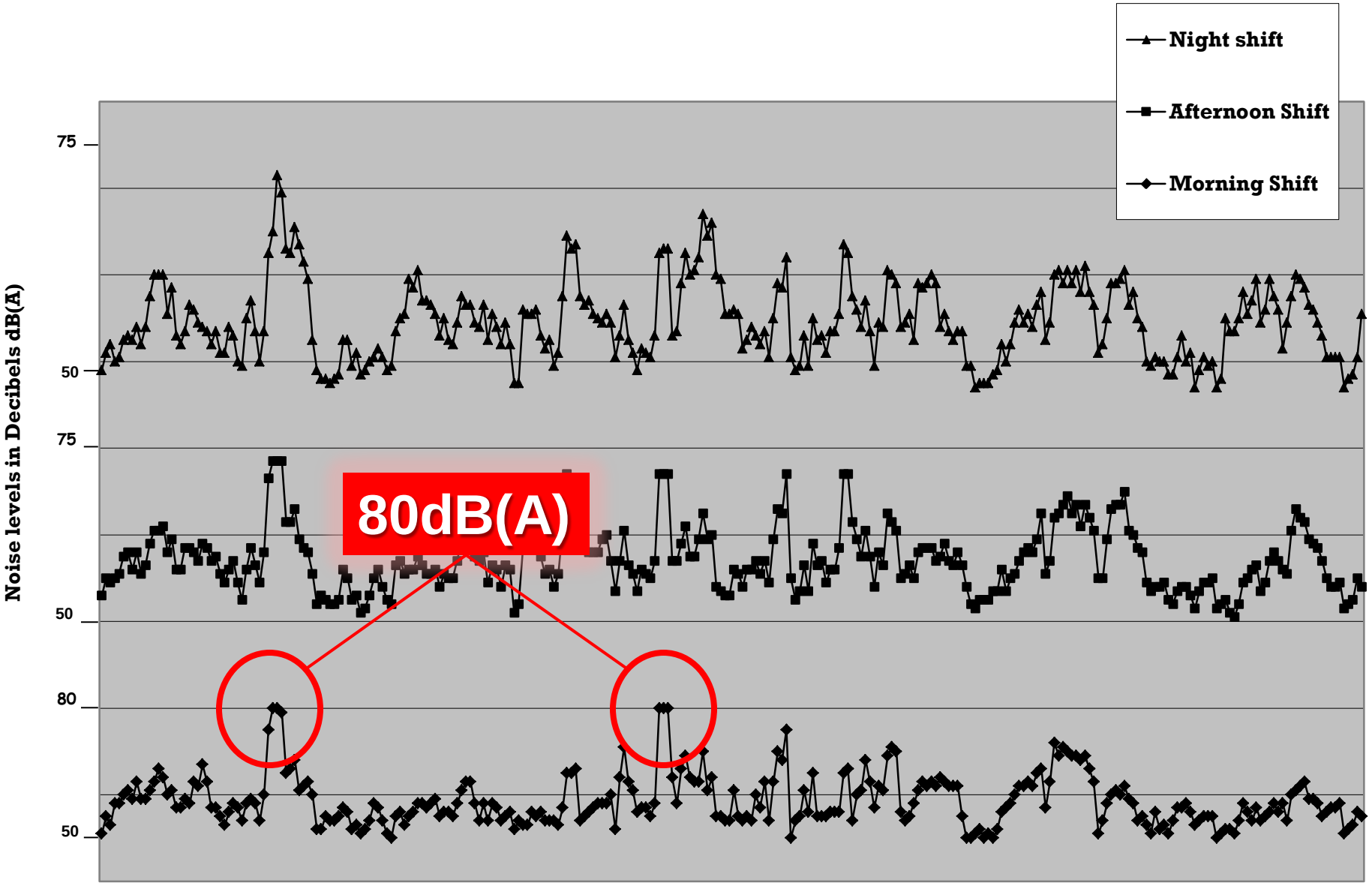
Noise Levels in a General Intensive Care Unit

Nursing in Critical Care, 2007, 12(4), 188-197.

- Is there a fluctuation in noise levels over a 24-h period in the ICU?
- Is there a difference in noise levels over the three different nursing shifts in a 24-h period?
- Is there a difference in noise levels over different days of the week?
- Does the overall mean noise level measured in ICU conform to the WHO's recommended maximum permitted noise level in hospitals?

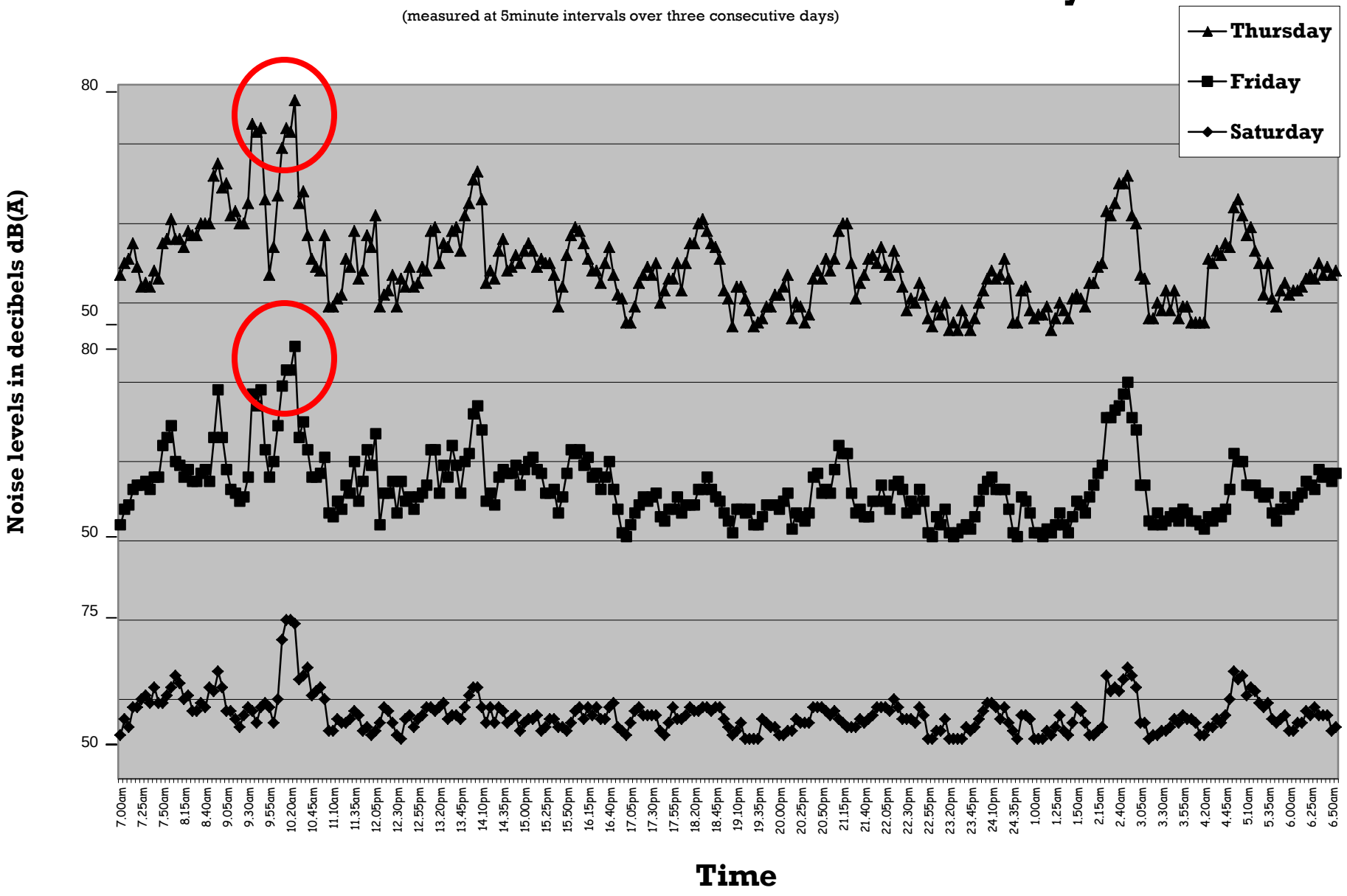
Pooled Noise Distribution of 3 Nursing Shifts

(measured at 5 minute intervals over3 consecutive days)



Pooled Noise Distribution over Three Days

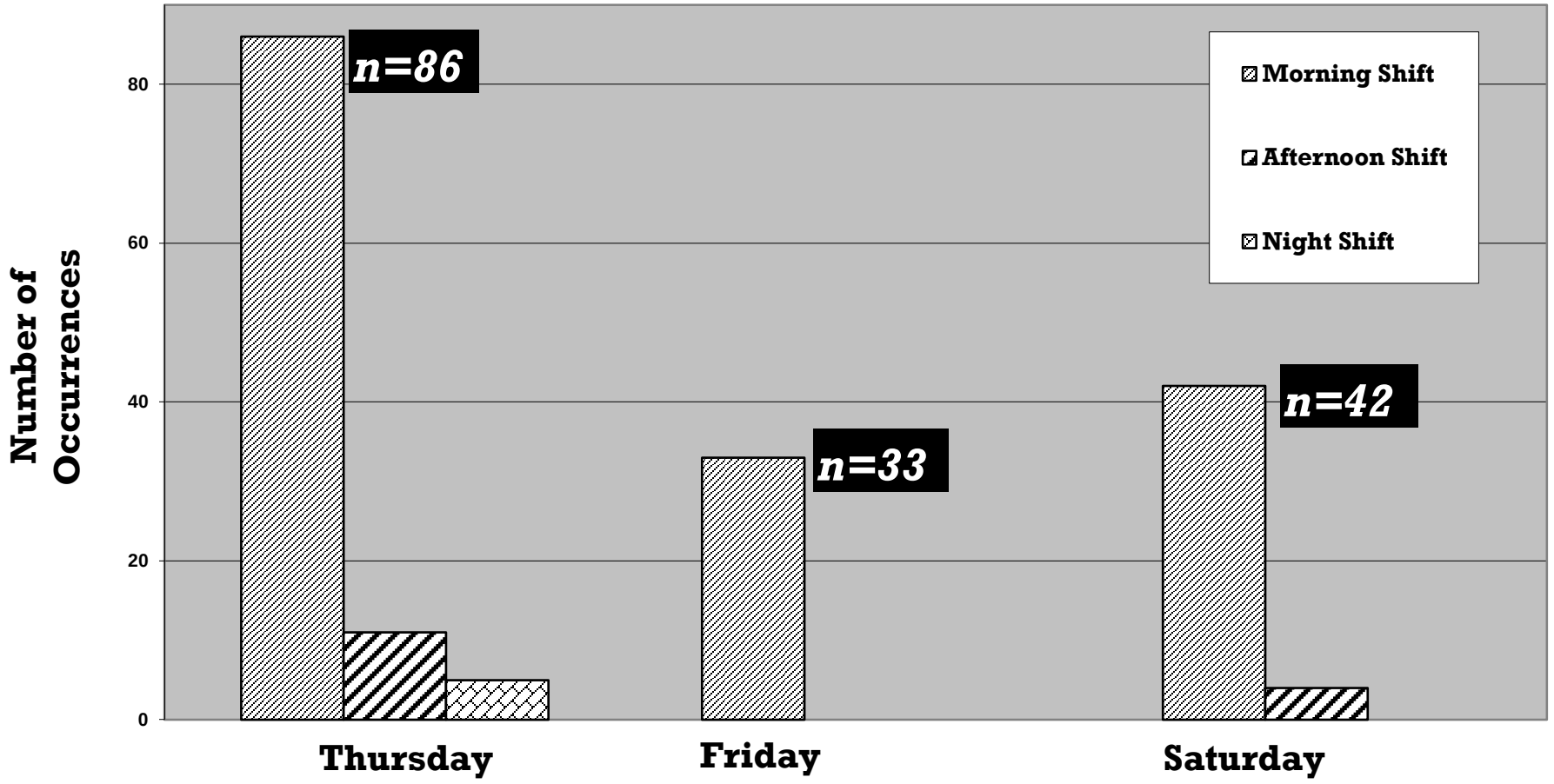
(measured at 5minute intervals over three consecutive days)



Variable:	Mean: dB(A)	Std Dev:	Minimum: dB(A)	Maximum: dB(A)
Intensive Care Unit (Over 3 Days)	56.42	5.22	50	80
Week-Day (Thursday & Friday)	56.75	5.37	50	80
Weekend (Saturday)	55.75	4.85	50	72
Morning Shift (0700-1530)	58.70	5.95	50	80
Afternoon Shift (1345-2130)	55.50	3.98	50	80
Night Shift (2045-0730)	55.05	2.34	50	71
Thursday	56.22	4.68	50	80
Friday	57.28	5.94	50	80
Saturday	55.75	4.85	50	72

Pooled Noise Levels >60dB(A) over 3 Nursing Shifts

(measured over 3 consecutive days)



Psychophysiological Disturbance

Mean ICU Noise

50dB(A)

Conclusions!

- ICU decor was partly responsible for noise generation inasmuch it was similar to an echo chamber.
- Mechanical noise was attributed to low frequency back-ground noise with occasional spikes due to alarms.
- Human interaction accounted for the majority of the noise produced.
- Noise levels varied according to the type of patient being cared for.

Level 2 Patients

More mechanical noise from CPAP/BiPAP and Oxygen Therapy

Level 3 Patients

Staff Conversation

Noise & Nursing Care

- Understood the need for sleep.
- Could not differentiate between essential and non-essential procedures and acceptable levels of noise.
- Nursing staff felt that because the majority of patients were critically ill, sedated and mechanically ventilated, the need for noise reduction was not applicable.
- Therefore, the taking and recording of observations was done primarily because of the nature of the job.

Morgan and White, 1983; Balogh et al., 1993; Kam et al., 1994.

What knowledge do ICU nurses have with regard to the effects of noise exposure in the Intensive Care Unit?

Intensive and Critical Care Nursing, 2005, 21, 199—207

- Explore the awareness of nursing staff in relation to noise pollution within their respective clinical area.
- Describe and compare nurses understanding and knowledge of the psychophysiological effects that excessive noise has on the body.

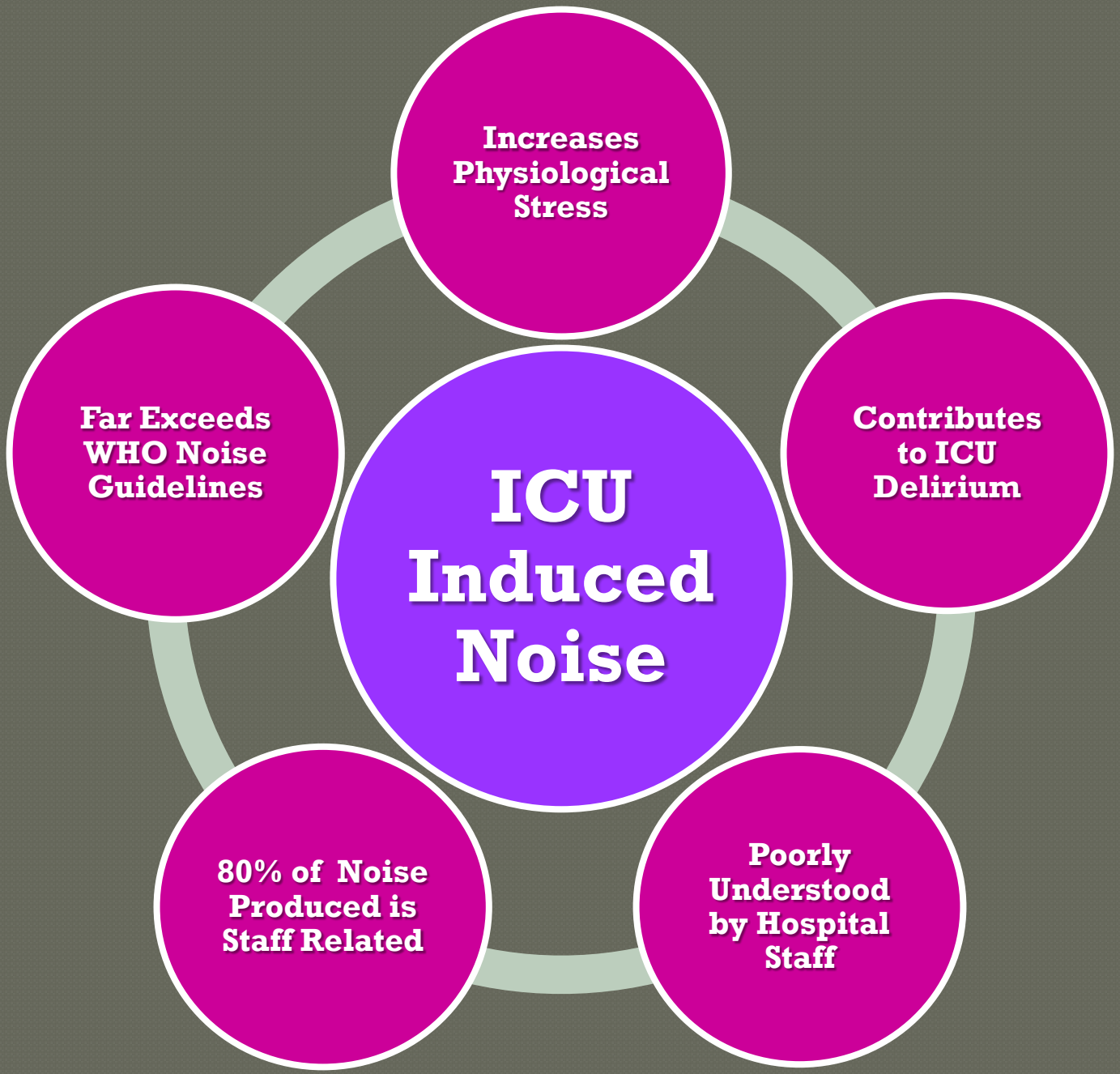
Psychological – **Physiological** – **Socio-Political**

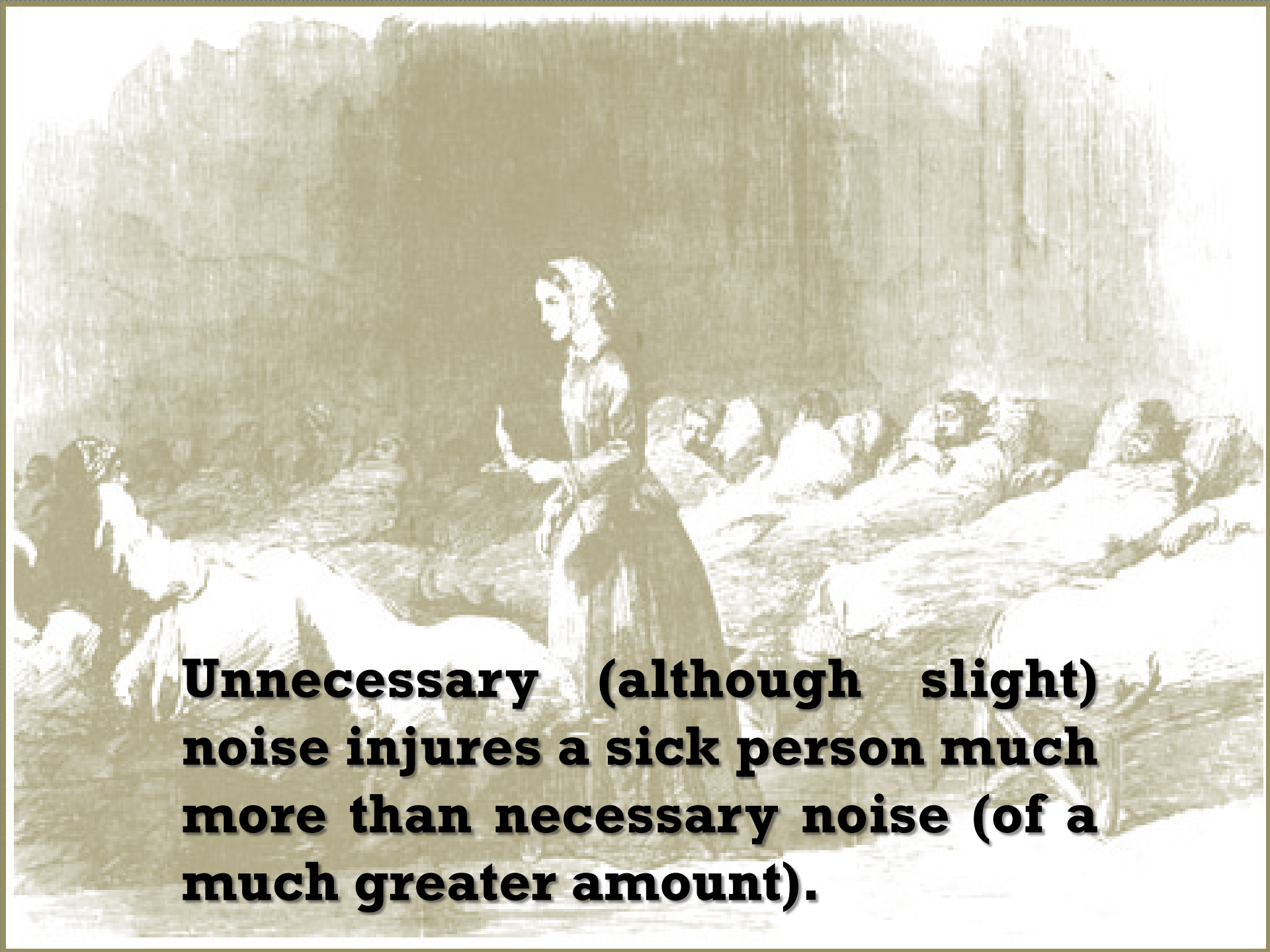
Categorised Questions Answered Correctly According to Nursing Seniority

Questions (n=15)	Staff Nurse (n=80)	Junior Sister/Charge Nurse (n=9)	Senior Sister/Charge Nurse (n=7)
Socio-Political (n=5)	75	7	4
Physiological (n=6)	78	9	8
Psychological (n=4)	65	7	6
Total Answered Correctly	218 (18%) n= 1200	22 (16%) n=135	18 (17%) n=105

Conclusions

- Little awareness of current noise control legislation
- 50% of respondents agreed that medical and nursing staff were responsible for the noise produced within this respective clinical area.
- 50% of respondents could identify a specific level of noise
- Only 10% of respondents could answer correctly the physiological stress response to excessive noise.
- 80% of respondents could identify the behaviours associated with ICU delirium but associated these behaviours with lighting or sleeping in a strange bed .


ICU Induced Noise
Increases Physiological Stress
Contributes to ICU Delirium
Poorly Understood by Hospital Staff
80% of Noise Produced is Staff Related
Far Exceeds WHO Noise Guidelines



Unnecessary (although slight) noise injures a sick person much more than necessary noise (of a much greater amount).


Nurses
The Original Noise-Busters

Thank You for Listening